Table 4.1a. Nonpoint sources of common metal pollutants in urban watersheds. Industrial discharges can also be the source of these metal pollutants. (Sources of information: reviews in Paul and Meyer 2001 and Woodcock 2002.)

Metal Pollutant	Typical Source of Pollutant
cadmium	tires; lubricating oils; coatings on galvanized metals
chromium	brake linings; tires; engine parts (e.g., wheel bearings)
copper	brake linings; tires; engine parts
iron	corrosion product of vehicles
lead	brake linings; tires
manganese	engine parts
nickel	brake linings; tires; engine parts (e.g., wheel bearings); lubricating oils; diesel fuel
zinc	tires; lubricating fluids; galvanized auto parts; galvanized culverts

Table 4.1b. Comparison of metal concentrations in water column samples between the South Portland Engineering study (1994) and the present study. In the 1994 study, water samples were collected near where both Long Creek and Red Brook each enter into Clark's Pond. *1994 Study*: Federal standards were listed as follows: copper: 1000 ppb, lead: 50 ppb, and zinc: 5000 ppb. Low-flow (background) sampling occurred on October 5, 1992, a "pre-leaf-drop" date which had been through an eight-day period without rain. Stormwater sampling for the study occurred during an 1.79" rain storm over a 15 hr period on August 18, 1994 (8/94). Long Creek was termed "Jackson Brook" in the 1994 report (South Portland Engineering Department 1994). *Present Study*: Two sets of values are presented from the present study. The March 2000 (3/00) storm was a 1.6" storm over 29 hours and the September 2001 storm (9/01) was a 1.71" storm over 24 hours. In the "low-flow" table, the maximum concentrations measured over 3 low-flow events are presented.

Metal Pollutant	Maximum Concentration Obtained During a Storm (ppm)									
	1994 Study		Present Study							
Site:	LC-0~	RB-0~	LC-S-0.186	LC-S-0.186	LC-M-0.595	LC-M-0.595	LC-N-0.585	LC-N-0.585	RB-1.694	RB-1.964
Date:	8/94	8/94	3/00	9/01	3/00	9/01	3/00	9/01	3/00	9/01
copper	0.007	0.008	0.044	0.007	0.021	0.015	0.018	0.013	<0.002	0.003
lead	0.003	0.009	0.090	0.007	0.052	0.025	0.031	0.015	0.003	0.004
zinc	0.050	0.070	0.270	0.062	0.200	0.110	0.140	0.120	0.024	0.023

Metal Pollutant	Maximum Concentration Obtained During Low-Flow Conditions (ppm)					
	1994 Study		Present Study			
Site:	LC	RB	LC-S	LC-M	LC-N	RB
copper	0.008	0.005	0.002	<0.002	<0.002	<0.002
lead	0.005	<0.001	<0.003	<0.003	<0.003	<0.003
zinc	0.025	0.025	0.007	<0.005	0.015	0.009

Table 4.2. Comparisons between Guay's (2002) stormwater study of a "flashy" urban tributary (~40% PTIA) of Frost Gully Brook in Freeport, Maine. The storms included in this table either were his larger or most intense storm events. "FG-ut (#)" indicates Frost Gully Brook-urban tributary and the particular event sampled, while LC-S indicates sites LC-S-0.186 (PTIA = 47%) from this study. Data from Guay (2002) are samples that were collected during the "first flush" of storm event sampling, while data from Long Creek were collected during the "rise-to-peak" of the hydrograph, were maximum values observed, and considered to be fairly comparable. Specific conductivity is discussed later in this section. An asterisk (*) indicates that the value is expressed as ppm of nitrogen. ** Guay noted high turbidity during FG-t #4, apparently due to winter road sand. *** These precipitation values represent the major periods of rain during which monitoring took place and not periods of drizzle or trace precipitation.

Storm #	Storm Type	TSS (ppm)	Total-P (ppm)	TKN (ppm)	$NO_2 + NO_3$ (ppm)
FG-ut (#2)	0.70"/7 hours in November 2000	29	0.052	0.5	0.60
FG-ut (#4)	0.25"/2.5 hrs in May 2001 **	2520	2.500	6.5	0.45
FG-ut (#5)	0.90"/3 hours in September 2001	530	1.100	4.6	0.75
LC-S (#1)	1.30"/7 hours in March 2000 ***	563	0.690	1.9	0.26
LC-S (#2)	1.10"/21 hours in October 2000 ***	20	0.074	1.0	20.00
LC-S (#3)	1.6"/12 hours in September 2001 ***	70	0.100	0.6	0.31

Table 4.3. A summary of findings on temperatures observed to be detrimental to brook trout as reported in a literature review written by McCullough (1999). Please refer to his document for more complete information. Part I details information about field observations while Part II details information about laboratory experiments.

I. *Field Observations*

Upper Limit of Temperatures Where Brook Trout Were Observed(°C)	Comments
a) 22	a) Upper limit (3-week mean temperature) for self-sustaining populations in southern Ontario streams (Barton et al. 1985).
b) 25.6	b) Upper limit (instantaneous observed temperature) for self-sustaining populations in southern Ontario streams (Barton et al. 1985).
c) 22-24	c) Various Ontario streams (Meisner 1990; also see review in Meisner 1990)
d) 19-20	d) Various Virginia streams (Burton and Odum).
e) 22.3	e) A study analyzed a large national database of brook trout presence/absence data and weekly mean temperatures. The authors eliminated the upper-end 5% of temperatures where brook were found to be present to get a more conservative estimate of an upper thermal tolerance limit. After eliminating the upper-end 5%, they found the 95%-ile thermal tolerance temperature to be 22.3 °C (Eaton et al. 1995).
f) 19-20	f) Self-sustaining populations of brook trout tend to be limited to stream zones with temperatures < 19-20 °C (review in Hokanson et al. 1973).

II. *Laboratory Experiments*

Brook Trout Life Stage	Important Temperatures (°C)	Comments
Egg / Alevin	a) > 16	a) When pre-spawning brook trout adults were held in 16 °C water, the percentage of normal egg hatching was 0%. As test temperatures were lowered, percent-hatching increased. At 6-8 °C, percent hatching was > 90% (Hokanson et al. 1973).
	b) > 15 > 9	b) When eggs were held at 1.5 - 9.0 °C, percent survival to hatching was 80-85%. Percent survival to hatching was 0% at 15 °C. (Hokanson et al. 1973, Humpesch 1985).
	c) ≥ 18	c) Considered detrimental to newly hatched alevins (McCormick et al. 1972).
Juvenile	d) 24[a] - 25.5[b]	d) Range of upper incipient lethal temperatures (UILT) determined by [a]Cherry et al. (1977) and [b]Fry et al. (1946). [UILT = a temperature, given a previous acclimation to a constant temperature, that 50% of the fish can tolerate for 7 days. The acclimation temperature for "[b]" was 24 °C, while it was not reported for "[a]".]
Adult	e) 16-19	e) For spawning female brook trout (Hokanson et al. 1973).
	f) 19	f) For spawning male brook trout (Hokanson et al. 1973).
	g) 9	g) Optimal conditions for spawning brook trout (Hokanson et al. 1973).